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(54) Apparatus for near vertical laying of pipeline

Vorrichtung zum vertikalen Rohrverlegen

Dispositif pour la pose verticale de tuyaux

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(73) Proprietor: **McDERMOTT INTERNATIONAL, INC.**
New Orleans, Louisiana 70160 (US)

(72) Inventor: **Wilkins, Jesse Ray**
Picayune, Mississippi 39466 (US)

(74) Representative: **Pilch, Adam John Michael et al**
D. YOUNG & CO.,
21 New Fetter Lane
London EC4A 1DA (GB)

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Description

[0001] The invention is generally related to the laying of pipeline and particularly to the near vertical laying of pipeline offshore such as in deep water.

[0002] The laying of offshore pipelines has been done for many years utilizing the technique referred to as S-lay. In the S-lay technique, joints of pipe are added to the pipeline in a horizontal position on the deck of a lay barge. The pipeline then curves over the stern of the barge, angles down toward the seabed, curves back to horizontal and lays on the seabed. The profile of the pipeline from the lay barge to the seabed is in the form of a long "S", which leads to the name of S-lay.

[0003] Although S-lay has been the method of choice for virtually all pipeline installed to date, there are physical limitations on the use of this technique. Chief among these is water depth. As the water depth increases, the ability to move the vessel on anchors becomes more and more difficult and the horizontal component of the pipe tension becomes greater and greater. The offshore pipeline industry has been aware of this problem for years and has as a solution, accepted the concept of near vertical lay, called J-lay, as the system of choice for deep water pipe laying. It should be understood that the definition of deep water, when referring to the use of J-lay, is a direct function of pipe diameter. This relationship is a result of the minimum water depth required for pipe of a certain diameter to achieve the proper flex during the vertical laying operation. There is also a maximum practical depth for specific pipe diameters. As an example, pipe having a diameter of 168.3 mm (6.625 inches) requires a minimum water depth, with no water in the pipe, of 37.8 m (124 feet). At the opposite end of the scale, pipe having a diameter of 1.07 m (42 inches) requires a minimum water depth, with no water in the pipe, of 407.5 m (1,337 feet).

[0004] Considerable work has been done over the years on the theoretical aspects of the J-lay concept, but very little work has been done on the actual hardware and equipment needed for this type of system. Most of the systems proposed have utilized existing semi-submersible drilling units. These units, which are capable of being modified for this service, were not built to be used as pipe layers and cannot be made to be very efficient during pipe laying operations.

[0005] Another problem area in laying pipeline offshore is the storage, transportation, and transfer of pipe to the lay vessel. In normal operations, the line pipe for the pipeline is transported to the field in forty feet (12.2 m) long joints. The transport vessel, which is usually a small material barge or a special purpose pipe haul boat, is tied to the side of the lay vessel as the pipe is transferred to the lay vessel. Transfer of the pipe, one joint at a time, may take several days. The transfer of pipe from between vessels subject to sea-induced motion is hazardous to personnel and equipment under good sea conditions and becomes impossible to do safely under bad conditions.

[0006] Applicants are aware of a system that utilizes a ramp that can be adjusted from horizontal to vertical. It uses large tensioners to grip the pipe and apply the necessary amount of tension to the system. This system has never been used for deep water pipeline construction.

[0007] Offshore pipe laying systems, those in use (S-lay) and theoretical proposals (J-lay), have certain things in common. The systems may or may not use pipe add-ons that have been multi-jointed outside the system to provide pipe joint lengths greater than the normal forty foot (12.2 m) pipe length. Theoretical J-lay systems have proposed joint lengths of eighty feet (24.4 m) or more. A single station is used to accomplish the welding, NDT (non-destructive testing), and pipe coating of joints. In J-lay, it is necessary to have a means to transfer the pipe from the horizontal position on the lay vessel to a near vertical position on the lay line. It is also necessary to have some means of lowering the pipe as the lay vessel moves forward. A particular problem in this area has been the issue of devising an efficient manner of transferring the load of the pipeline to a holding mechanism so that the lowering mechanism can then be raised in preparation for receiving the weight of the pipeline after addition of the next pipe joint. EP-A-657 670 describes an apparatus for near vertical laying of pipeline that includes a tower on the lay barge that supports the weight of the flooded pipeline and uses a travel block and pedestal arrangement that allows for a ready weight transfer of the pipeline from the travel block to the pedestal during lowering of the pipeline after a new pipe joint has been added. A problem with the system as described is that the major loads of the pipeline are carried through compression in the tower during lowering. This puts large loads above the vessel deck on a continuous basis and raises the centre of gravity of the system above the normal centre of gravity of the vessel.

[0008] Patent specification GB-A-2 095 787 discloses a pipelaying vessel wherein pipe lengths to be welded to a pipeline are fed to a swing arm, pivoted about a transverse axis, and used to raise the pipe lengths to an upright orientation. A gripper carriage holds the pipe length and is movable in a laying tower by a cable.

[0009] According to the present invention there is provided apparatus on a vessel suitable for near vertical laying of a pipeline offshore, the apparatus comprising:

a support base mounted on the vessel;

a framework mounted on said support base and extending upwardly therefrom;

a pipe joint alignment tower pivotally attached to and supported by said support base and said framework;

a support tower pivotally attached to said support base and extending downwardly from said support base;

a pedestal at the lower end of said support tower,

said pedestal being operable to releasably receive and support the weight of the pipeline; and
a travel block received in said support tower so as to be movable along the length of said support tower to releasably receive and support the weight of the pipeline;

characterised in that:

a plurality of buckle arrestors are provided at selected intervals on the pipeline;
said pedestal is operable to releasably receive and support the pipeline by one of said buckle arrestors; and
said travel block is movable along the pipeline and is operable between a first open position and a second closed position to releasably receive and support the weight of the pipeline by one of said buckle arrestors when said travel block is in the second closed position, in cooperation with said pedestal.

[0010] In a preferred embodiment of the invention, the apparatus lowers the centre of gravity of the system to below that of the vessel. The alignment tower that extends above the deck of the vessel supports the weight of only one multijoint of pipe and an internal lineup clamp and storage and transfer system. The support tower, which can be in the form of a stinger, that supports the weight of the flooded pipeline, extends below the vessel into the water. The travel block and pedestal used to support and lower the pipeline in the tower are positioned in the tower. The travel block is moved in and out of the water along the length of the tower during operations.

[0011] The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Fig. 1 is an elevation view of one embodiment of the invention;
Fig. 2 is a detail view that illustrates the junctures of a support base, an alignment tower, and a support tower shown in Fig. 1;
Fig. 3 is a detail view that illustrates the lower end of the support tower;
Fig. 4 is a detail view that illustrates the lower end of the support tower with a travel block near the pedestal;
Fig. 5 illustrates an alternative embodiment of the invention;
Fig. 6 illustrates a detail view of a stinger support framing and upper end of the stinger of the alternative embodiment;
Fig. 7 illustrates a detail view of the lower end of the stinger of the alternative embodiment with the travel block at the lower end of the stinger.

[0012] Referring to Fig. 1, apparatus 10 for near vertical laying of pipeline generally comprises a support base 12, a framework 14, a pipe joint alignment tower 16, a support tower 18, and means in said support tower 18 for receiving and supporting the weight of a pipeline 20.

[0013] The support base 12 is rigidly attached to a lay vessel 22. In the preferred embodiment, the support base 12 is arranged to pivotally receive both the alignment tower 16 and the support tower 18. The support base 12 and the apparatus 10 are illustrated in Fig. 1 and 2 as being positioned amid-ships on the lay vessel 22 at which is commonly referred to as a moon pool. However, it should be understood that the apparatus 10 may also be positioned at a side or the stern of the lay vessel 22 to accommodate the specific needs of the pipe laying operation.

[0014] The framework 14 is rigidly attached to the support base 12 and extends upwardly therefrom. The framework 14 provides support to the pipe joint alignment tower 16.

[0015] The pipe joint alignment tower 16 is lightly framed as it only has to support the weight of one joint or multijoint of pipe and the internal lineup clamp and transfer system. The pipe joint alignment tower 16 is a U-shaped frame open on one side along its length and is designed to support the weight of the pipe joint during welding to the pipeline. As seen in the phantom views in Fig. 1, the pipe joint alignment tower 16 is attached to the support base 12 and the framework 14 so that it may be selectively positioned at several different angles according to that required during pipe laying operation. The pipe joint alignment tower 16 is in alignment with the support tower 18.

[0016] The support tower 18 is pivotally supported at its upper end in the support base 12 by support framing 24, best seen in Figure 2. As indicated by the phantom views in Figure 1, the support framing 24 provides for selective pivoting of the support tower 18 according to needs of the pipe laying operations as mentioned above for the pipe joint alignment tower 16. The support tower 18 is designed to be able to support the weight of the flooded pipeline during pipe laying operations. Means for receiving the weight of the pipeline is provided in the form of a travel block 26 and a pedestal 28, seen in Fig. 2-4. The travel block 26 and the pedestal 28 are used in cooperation to support and lower the pipeline after a pipe joint has been added. The pedestal 28 supports the weight of the pipeline at a buckle arrestor 30 while a pipe joint is being added to the pipeline. After addition of the new joint, the travel block 26 is raised to pick up the pipeline load, the pedestal 28 is opened, and then the travel block 26 is lowered in the support tower 18 via a winch 32, a cable 34, and a crown block 36 and the weight of the pipeline is transferred to the pedestal 28. The travel block 26 is then raised back to the upper end of the support tower 18 in preparation for addition of another pipe joint to the pipeline while the pedestal 28 supports the

pipeline. Although any suitable equipment may be used to achieve the operations required of the travel block 26 and the pedestal 28, the travel block and pedestal configuration described in EP-A-657 670 is preferred for the most efficient and time saving weight transfer.

[0017] The transfer of pipe joints from a horizontal orientation on a pipe ready rack into the pipe joint alignment tower 16 is illustrated as being accomplished by the use of an alignment boom 38 that is pivotally attached to the pipe joint alignment tower 16. However, it should be understood that any suitable transfer means such as a strongback may also be used.

[0018] In operation, the pipe joint alignment tower 16 and the support tower 18 are aligned with each other and set at the angle required for the pipe laying operations according to pipe size and water depth. A single pipe joint has its ends prepared for welding to the pipeline and is transferred to a pipe ready rack.

[0019] The alignment boom 38, or any suitable equipment, receives the pipe joint from cranes and is then pivoted upwardly as indicated by the arrow and line in Fig. 1 to transfer the pipe joint to the pipe joint alignment tower 16. Clamps provided in the pipe joint alignment tower 16 receive the pipe joint and hold it in place while it is welded to the pipeline 20. The clamps provided in the pipe joint alignment tower 16 are preferably adjustable to allow for precise alignment of the pipe joint and the pipeline. A work deck 40 is provided for personnel and the necessary equipment to carry out the welding and testing operations. During the addition of the pipe joint, the pedestal 28 supports the pipeline at the buckle arrestor 30 on the pipeline. An internal line up clamp will typically be provided at the upper end of the pipe joint alignment tower 16 for lowering into the pipe joint to the abutting surfaces of the pipe joint and pipeline. Buckle arrestors are provided at selected intervals along the pipeline to prevent buckling of the pipe during laying operations. After the welding, testing, and coating operations are complete, the travel block 26 takes the load from the pedestal 28 and is lowered in the support tower 18 as the lay vessel moves forward. Fig. 3 illustrates the buckle arrestor 30 at the pedestal 28 as it supports the pipeline 20 during welding of the next joint and the raising of the travel block 26 while Fig. 4 illustrates a just completed transfer between the travel block 26 and the pedestal 28 as the travel block 26 is beginning to be moved back to the upper end of the support tower 18 in preparation for attachment of another pipe joint. The travel block 26 is moved to the upper end of the support tower 18 and used to support the pipeline at a buckle arrestor after completion of welding. A pipe joint already positioned in the pipe joint alignment tower 16 is then welded to the pipeline 20 and the process is repeated. Besides providing for a lower center of gravity, the location of the travel block 26 below the work area eliminates the need to wait for the travel block to clear the work area before proceeding with work on attaching the next pipe joint to the pipeline.

[0020] Fig. 5-7 illustrate an alternate embodiment of the invention. The main difference in the alternate embodiment is that the large support tower 18 is replaced by a stinger 44, the pedestal is moved above the water line, and the travel block moves along the length of the stinger 44 in and out of the water. As seen in Fig. 5, the support tower shown in Fig. 1 is replaced by a stinger support frame 42 and stinger 44. As best seen in Fig. 6, the stinger support frame 42 is also pivotally supported in the support base 12 by the support framing 24. A pedestal 46 operates in a similar fashion as above so as to cooperate with the travel block 26 for receiving and transferring the weight of the pipeline between the pedestal 46 and the travel block 26. The pedestal 46 is provided with a clamp 48 that moves between an open position where it does not support the weight of the pipeline and a closed position where it does support the weight of the pipeline. Fig. 6 illustrates the pedestal clamp and travel block in position for transferring the weight of the pipeline to the travel block. As described above, the travel block 26 is supported and moved by the cable 34 across the crown block 36. The travel block 26 receives the weight of the pipeline from the clamp 48 by contact of the upper end of the travel block 26 with the buckle arrestor 30 on the pipeline. The travel block 26 is then lowered in the stinger 44 as the lay vessel 22 moves forward to lower and lay pipeline equal to the length of the pipe joint that has been added. The clamp 48 is then closed to receive a buckle arrestor on the pipeline and support the weight of the pipeline while another joint is added and the travel block 26 is opened to release the pipeline and raised back up to the pedestal 46. As illustrated by the dotted lines indicating a phantom view of the stinger 44, the lower portion of the stinger 44 is hinged such that it may be pivoted upward and locked in an inoperative stowed position to reduce its water depth and resistance to movement of the lay vessel 22 when pipe laying operations are not being conducted. As described above, the alternate embodiment is movable within a selected range of angles to provide the most desirable angle for pipe size and water depth. The alternate embodiment provides the additional advantages of the stinger 46 being lighter weight than the support tower 18 and the travel block 26 being the only moving part that is submerged in water below the vessel. The location of the pedestal 46 also keeps it out of the water and provides for easier maintenance.

Claims

1. Apparatus on a vessel suitable for near vertical laying of a pipeline (20) offshore, the apparatus comprising:

   a support base (12) mounted on the vessel (22);

   a framework (14) mounted on said support

base (12) and extending upwardly therefrom;
a pipe joint alignment tower (16) pivotally attached to and supported by said support base (12) and said framework (14);
a support tower (18) pivotally attached to said support base (12) and extending downwardly from said support base (12);
a pedestal (28,46) at the lower end of said support tower (18), said pedestal (28,46) being operable to releasably receive and support the weight of the pipeline (20); and
a travel block (26) received in said support tower (18) so as to be movable along the length of said support tower (18) to releasably receive and support the weight of the pipeline (20);

characterised in that:

a plurality of buckle arrestors (30) are provided at selected intervals on the pipeline (20);
said pedestal (28,46) is operable to releasably receive and support the pipeline (20) by one of said buckle arrestors (30); and
said travel block (26) is movable along the pipeline (20) and is operable between a first open position and a second closed position to releasably receive and support the weight of the pipeline (20) by one of said buckle arrestors (30) when said travel block (26) is in the second closed position, in cooperation with said pedestal (28,46).

2. Apparatus according to claim 1, including an alignment boom (38) pivotally attached to said pipe joint alignment tower (16) for transferring a pipe joint from the vessel (22) into said pipe joint alignment tower (16).

3. Apparatus according to claim 1, wherein said support tower (18) comprises a stinger support frame (42) pivotally attached to said support base (12) and a stinger (44) attached to the lower end of said stinger support frame (42) and extending downwardly therefrom; said travel block (26) being received in said stinger (44) so as to be movable along the length of said stinger (44).

4. Apparatus according to claim 3, wherein said stinger (44) is hinged at its lower portion to allow pivoting of the lower portion upwardly into a stowed inoperative position.

Patentansprüche

1. Vorrichtung auf einem Behälter zur nahen vertikalen Verlegung einer Pipeline (20) seewärts mit

einem Trägersockel (12), der auf dem Behälter (22) befestigt ist,

einem Gestell (14), das auf dem Trägersockel (12) befestigt ist und sich von diesem nach oben erstreckt,

einem Turm (16) für eine Rohrverbindungsausrichtung, der schwenkbar an dem Trägersockel (12) und dem Gestell (14) befestigt und von ihnen unterstützt ist,

einem Trägerturm (18), der an dem Trägersokkel (12) schwenkbar befestigt ist und sich von dem Trägersockel (12) aus abwärts erstreckt,

einem Fußsockel (28, 46) an dem unteren Ende des Trägerturms (18), wobei dieser Fußsokkel (28, 46) so wirkt, daß er das Gewicht der Pipeline (20) lösbar aufnimmt und unterstützt,

einem Flaschenzugblock (26), der von dem Trägerturm (18) so aufgenommen wird, daß er entlang der Länge des Trägerturms (18) bewegbar ist, um das Gewicht der Pipeline (20) lösbar aufzunehmen und zu unterstützen,

dadurch gekennzeichnet, daß

mehrere Schnallenstopeinrichtungen (30) in ausgewählten Abständen auf der Pipeline (20) vorgesehen sind,

der Fußsockel (28, 46) so arbeitet, daß er die Pipeline (20) durch eine der Schnallenstopeinrichtungen (30) lösbar aufnimmt und unterstützt, und

der Flaschenzugblock (26) entlang der Pipeline (20) bewegbar ist und zwischen einer ersten offenen Stellung und einer zweiten geschlossenen Stellung arbeiten kann, um das Gewicht der Pipeline (20) durch eine der Schnallenstopeinrichtungen (30) in Zusammenwirken mit dem Fußsockel (28, 46) lösbar aufzunehmen und zu unterstützen, wenn sich der Flaschenzugblock (26) in der zweiten geschlossenen Stellung befindet.

2. Vorrichtung nach Anspruch 1 mit einem Ausrichtungsausleger (38), der schwenkbar an dem Turm (16) für Rohrverbindungsausrichtung befestigt ist, um eine Rohrverbindung von dem Behälter (22) in den Turm (16) zur Rohrverbindungsausrichtung zu überführen.

3. Vorrichtung nach Anspruch 1, bei der der Trägerturm (18) ein Vorschubstangenträgergestell (42),

das an dem Trägersockel (12) befestigt ist, und eine Vorschubstange (44), die an dem unteren Ende des Vorschubstangenträgergestelles (42) befestigt ist und sich von ihm aus nach abwärts erstreckt, umfaßt, wobei der Flaschenzugblock (26) von dieser Trägerstange (44) so aufgenommen wird, daß er entlang der Länge der Trägerstange (44) bewegbar ist.

4. Vorrichtung nach Anspruch 3, bei der die Vorschubstange (44) in ihrem unteren Bereich angelenkt ist, um ein Verschwenken des unteren Bereiches aufwärts in eine eingezogene nichtarbeitende Stellung zu gestatten.

Revendications

1. Appareil sur un navire approprié pour la pose quasi verticale d'un pipe-line (20) en mer, l'appareil comprenant :

une base de support (12) montée sur le navire (22) ;
une ossature (14) montée sur ladite base de support (12) et s'étendant vers le haut depuis celle-ci ;
une tour d'alignement de raccords de tuyaux (16) fixée de manière à pivoter à, et supportée par, ladite base de support (12) et ladite ossature (14);
une tour de support (18) fixée de manière à pivoter à ladite base de support (12) et s'étendant vers le bas depuis ladite base de support (12) ;
un piédestal (28, 46) à l'extrémité inférieure de ladite tour de support (18), ledit piédestal (28, 46) étant adapté à recevoir avec possibilité de décharge et supporter le poids du pipe-line (20).; et
un palan mobile (26) reçu dans ladite tour de support (18) afin de pouvoir être déplacé le long de ladite tour de support (18) pour recevoir avec possibilité de décharge et supporter le poids du pipe-line (20) ;

caractérisé en ce que :

une pluralité d'arrêts anti-déformation (30) sont prévus à des intervalles sélectionnés sur le pipe-line (20) ;
ledit piédestal (28, 46) est adapté à recevoir avec possibilité de libération et supporter le pipe-line (20) par un desdits arrêts anti-déformation (30) ; et
ledit palan mobile (26) est adapté à être déplacé le long du pipe-line (20) et à opérer entre une première position ouverte et une seconde position fermée afin de recevoir avec possibilité de décharge et supporter le poids du pipe-line (20) par un desdits arrêts anti-déformation (30) lorsque ledit palan mobile (26) se trouve dans la seconde position fermée, en coopération avec ledit piédestal (28, 46).

2. Appareil selon la revendication 1, comprenant une flèche d'alignement (38) fixée de manière à pivoter à ladite tour d'alignement de raccords de tuyaux (16) pour transférer un raccord de tuyaux depuis le navire (22) dans ladite tour d'alignement de raccords de tuyaux (16).

3. Appareil selon la revendication 1, dans lequel ladite tour de support (18) comprend un châssis de support de bras (42) fixé de manière à pivoter à ladite base de support (12) et un bras (44) fixé à l'extrémité inférieure dudit châssis de support de bras (42) et s'étendant vers le bas depuis celui-ci ; ledit palan mobile (26) étant reçu dans ledit bras (44) afin d'être adapté à être déplacé le long dudit bras (44).

4. Appareil selon la revendication 3, dans lequel ledit bras (44) est articulé à sa partie inférieure pour permettre le pivotement de la partie inférieure vers le haut dans une position rentrée inopérante.

FIG.1

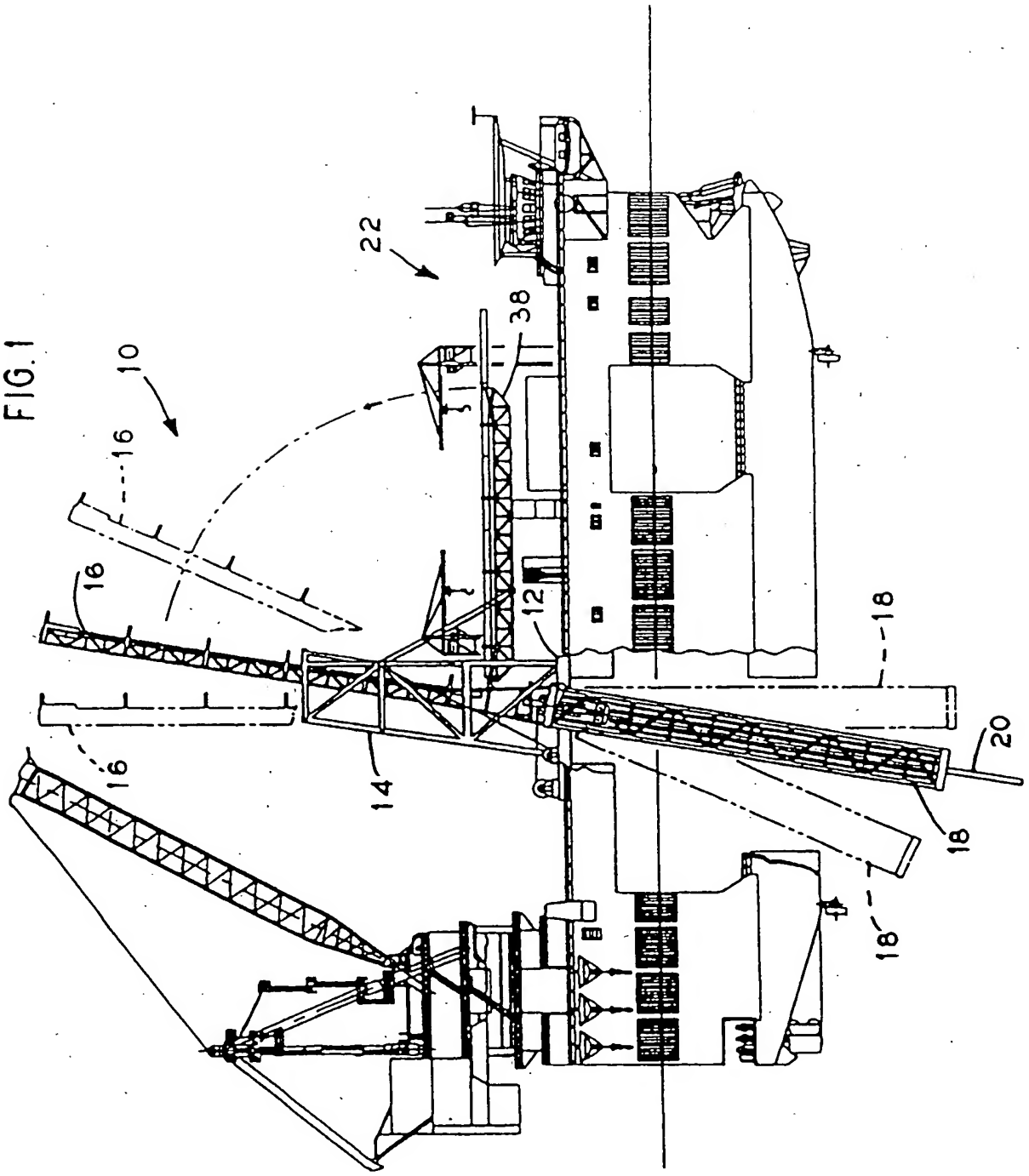

FIG. 2

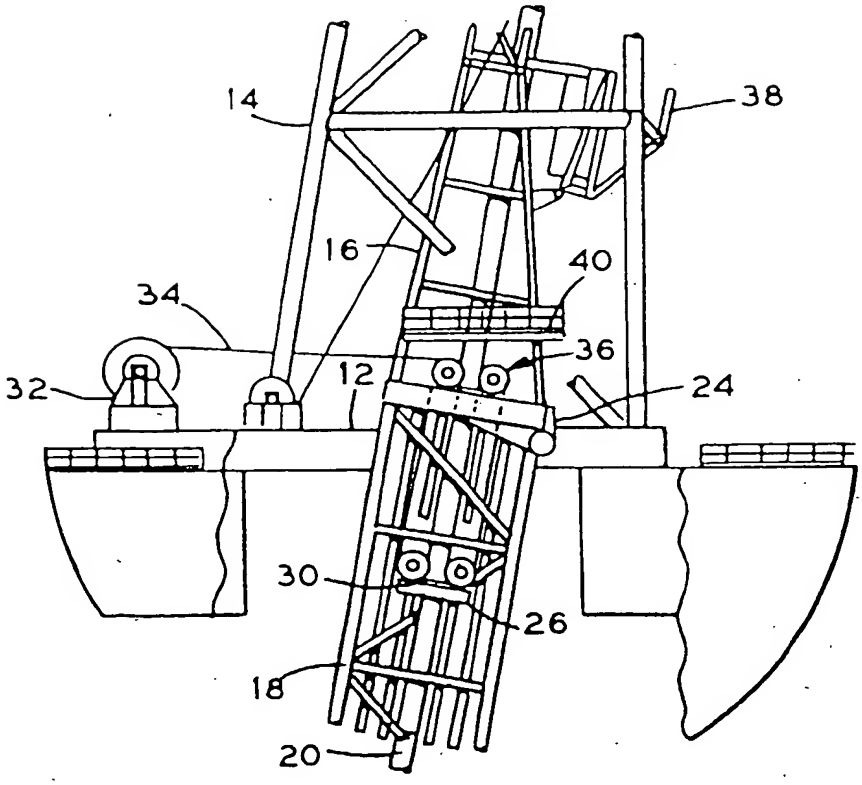

FIG. 3

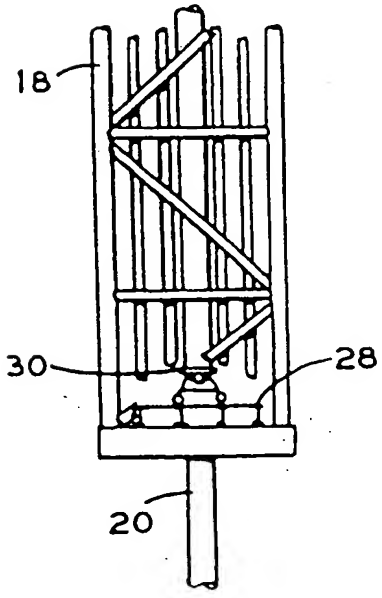

FIG. 4

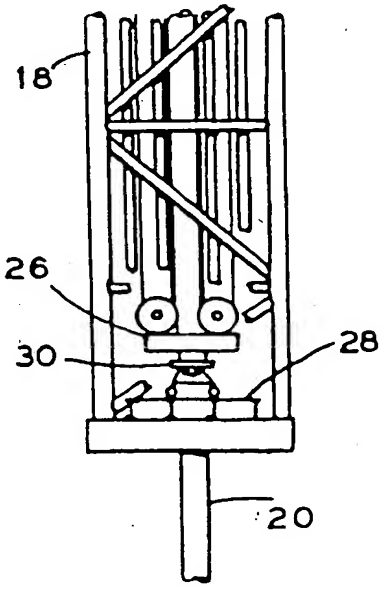

FIG.5

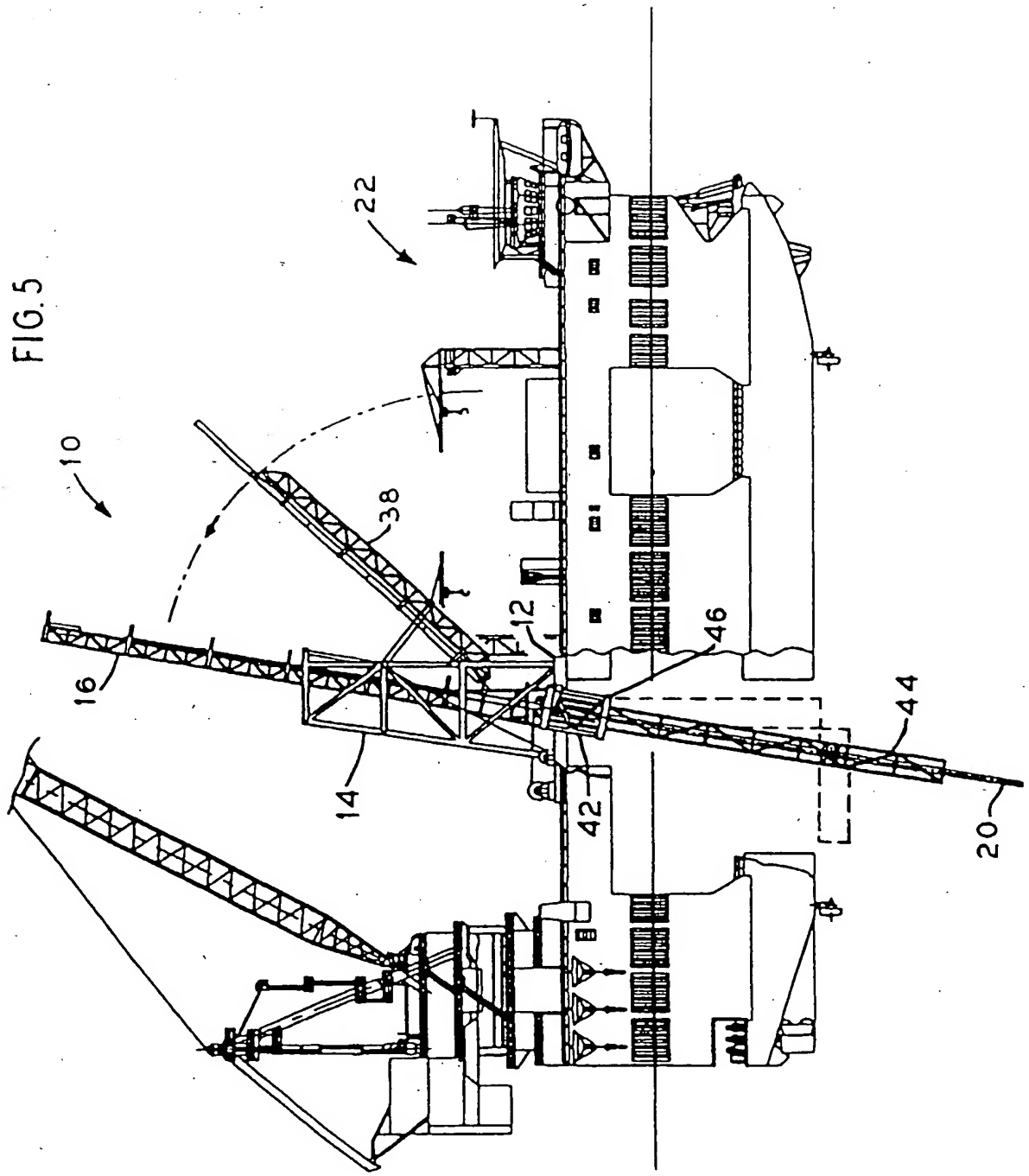

FIG.6

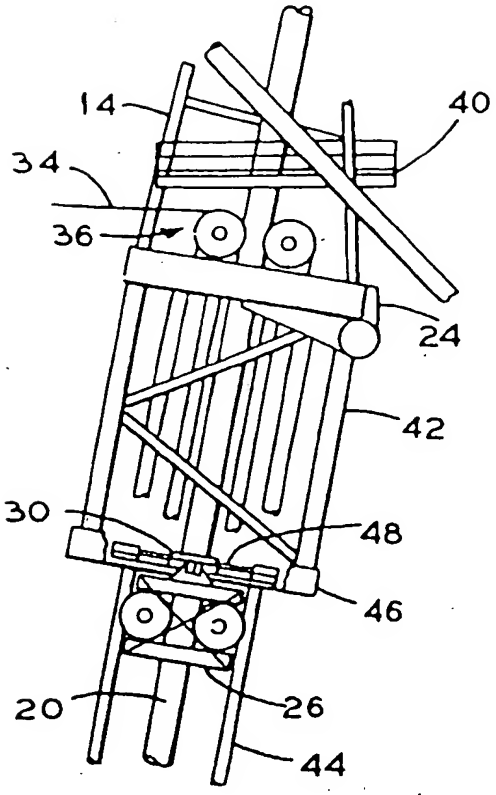

FIG.7